ASSEMBLY SELECT COMMITTEE ON CALIFORNIA WATER NEEDS AND CLIMATE CHANGE

SCIENTISTS TESTIFY ABOUT HOW CLIMATE CHANGE WILL AFFECT CALIFORNIA'S WATER FUTURE

SUMMARY OF AUGUST 25, 2003 HEARING

The Assembly Select Committee on California Water Needs and Climate Change, chaired by Assemblymember John Laird (D-Santa Cruz), heard testimony in the State Capitol from four premier climate scientists on how California's water systems will be effected by climate change over the next century.

The scientists testifying were:

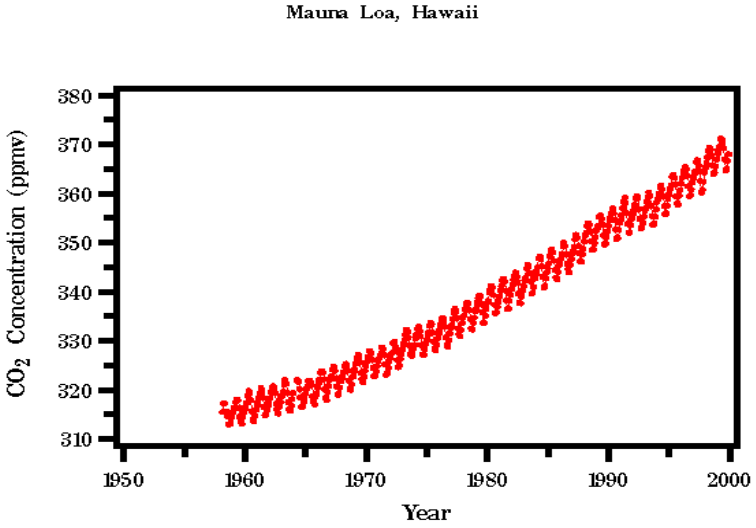
- Dr. Peter H. Gleick, co-founder and President of the Pacific Institute for Studies in Development, Environment, and Security,
- Dr. Daniel Cayan, Researcher, Climate Research Division, Scripps Institution of Oceanography, University of California; and Water Resources Division, United States Geological Survey
- Dr. Norman Miller, Lead Scientist, California Water Resources Research Center, Lawrence Berkeley National Laboratory, and
- Dr. Jay Lund, Department of Civil and Environmental Engineering, University of California, Davis.

Has the Science Community Decided Whether Climate Change is Real?

Dr. Gleick led off the hearing by stating that the scientific debate about whether climate change is real is over. He said that the question is now what the impacts of climate change will be and what to do about it.

When did the Concern about Climate Change Begin?

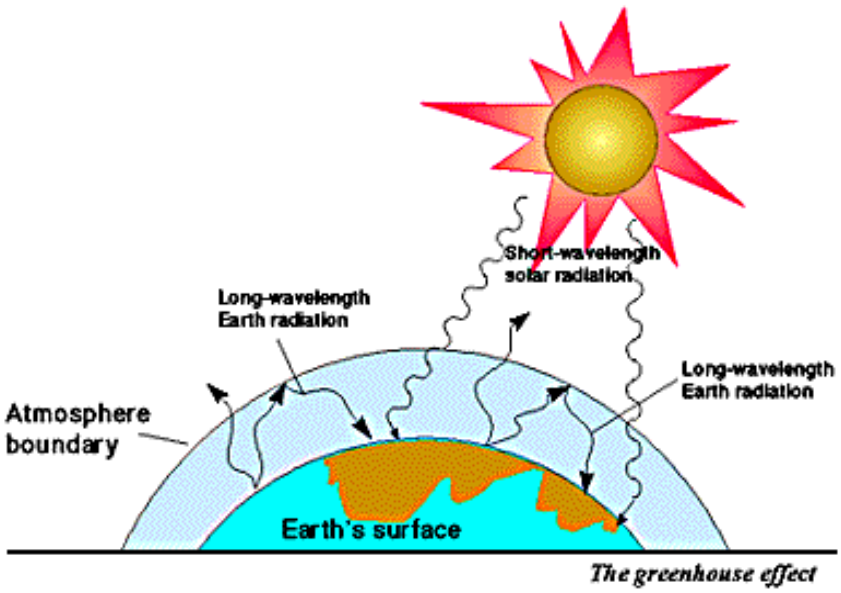
Global warming became a concern after Dr. Dave Keeling and Dr. Tim Whorf of the Scripps Institution of Oceanography determined that carbon dioxide in the atmosphere was steadily increasing:



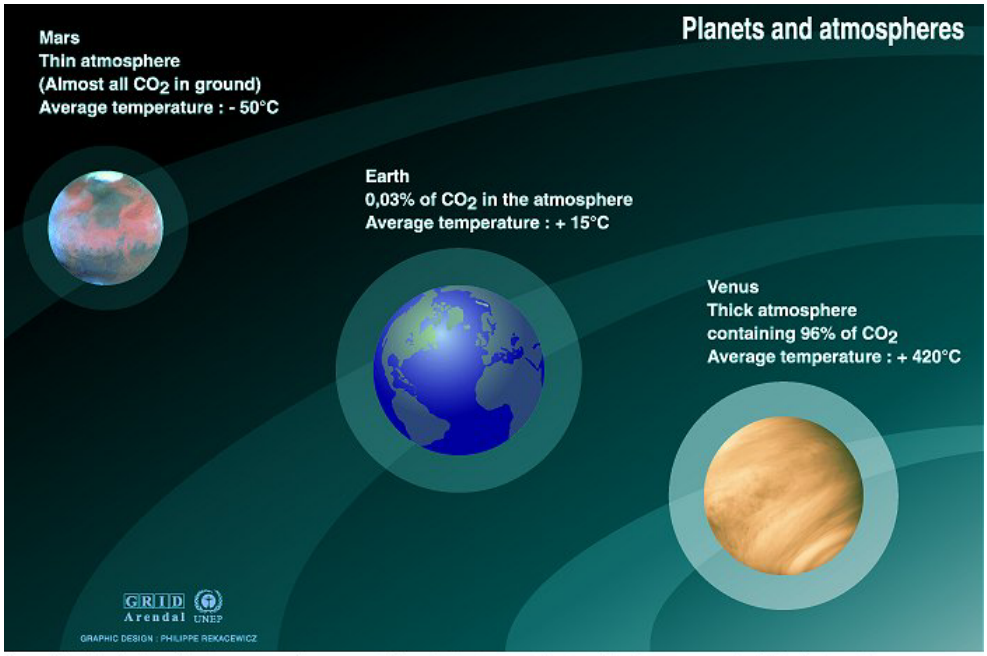
Source: Dave Keeling and Tim Whorf (Scripps Institution of Oceanography)

What is Global Warming?

The sun emits hot, short-wavelength sunlight that mostly passes through the atmosphere without being absorbed by gases in the atmosphere. Some of the light that reaches the Earth is absorbed by solids and liquids – thereby warming them. In turn, these objects emit cooler, long-wavelength radiation that can be absorbed by some gases in the atmosphere. When this radiation is absorbed by these gases, the heat energy is subsequently re-radiated, with some going into space and some going back to earth, thereby increasing the earth's temperature and causing the greenhouse effect.



Mars has a very thin atmosphere; few greenhouse gases; very little greenhouse effect; and a very cold temperature. The Earth has a thicker atmosphere, but only a tiny percentage of the gases in the Earth's atmosphere are greenhouse gases. The Earth's greenhouse gases increase the Earth's temperature about 25 degrees Fahrenheit, making the Earth livable in the manner that we know it. Venus has a very thick atmosphere containing 96 percent carbon dioxide. Venus' temperature is about 750 degrees hotter than it would be without its greenhouse gases.



Sources: Calvin J. Hamilton, Views of the solar system, www.planetscapes.com; Bill Arnett , The nine planets, a multimedia tour of the solar system, www.seds.org/billa/tnp/nineplanets.html

When Did Global Warming Begin?

The "beginning" was the beginning of the Industrial Age, when fossil fuels began being used as fuels.

What are the Greenhouse Gases, and are they Increasing?

The major greenhouse gases are carbon dioxide, ozone, methane, nitrous oxide, water vapor, and human-made chloroflorocarbons (CFCs). Carbon dioxide represents about one-half of the contribution of the climate-change gases and has a "lifetime" in the atmosphere of about a century.

Based on the Vostock ice cores from Antarctica, scientists determined that carbon dioxide concentrations in the atmosphere varied during glacial and interglacial periods, but never exceeded 300 parts per million over the last 400,000 years. Carbon dioxide is now almost 380 parts per million and is increasing more than one percent per year. By the end of the century,

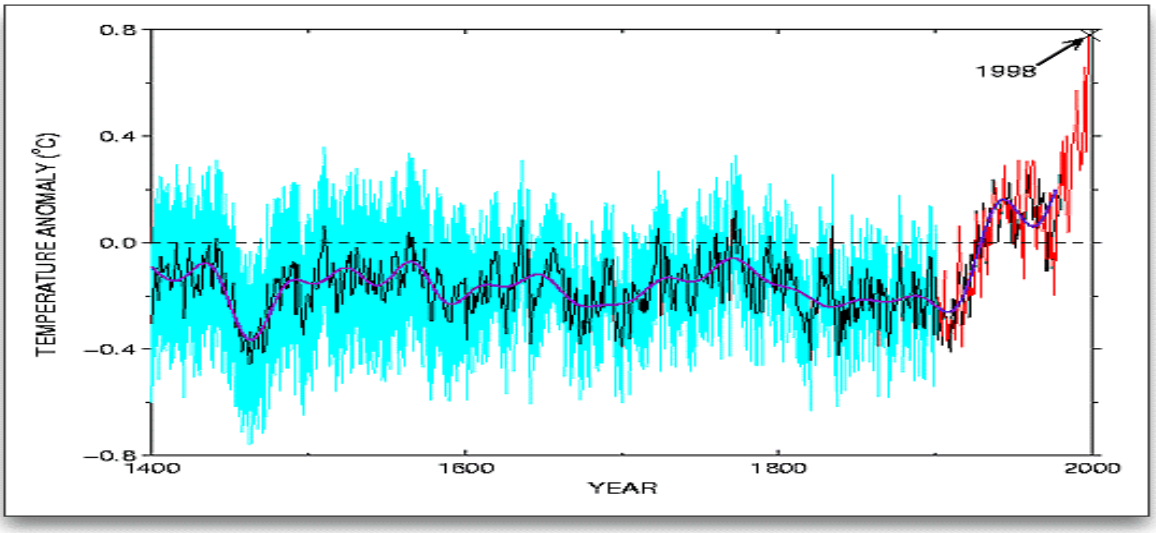
carbon dioxide concentrations are projected to double. Methane and nitrous oxide are also increasing.

Are Temperatures Increasing?

The Earth's atmosphere warmed about one degree Fahrenheit since the late 19th Century. Although this is not large, this change has had significant effects on the Earth's climate.

All of the major climate models project that there will be higher average temperatures, although the different models come to different conclusions regarding the amount of temperature increase. The average, worldwide increase in air temperature over the next 100 years is estimated to increase three to ten degrees Fahrenheit, although some areas may be warmer and some cooler.

Reconstructions of past climates suggest that global temperatures have risen at an extremely high rate in the last fifty years:



Is There Physical Evidence That Climate Change Is Already Occurring?

There is evidence worldwide. The 1990s were the warmest decade of the last century, and 1998 was the warmest year for at least the Northern Hemisphere. Glaciers are melting worldwide, especially at high elevations in the tropics; Mount Kilimanjaro in central Africa has lost 80 percent of its ice since 1912. Summer ice thickness in the Arctic has declined about forty percent. Spring temperatures in California have increased two to three degrees over the period 1950-1997. The peak snowmelt runoff has come two to three weeks earlier across the western United States. In many places vegetation is blooming one to three weeks earlier in the spring since the mid-1970s and continues to photosynthesize longer in the fall.

How Will Climate Change Affect The "Snowpack?"

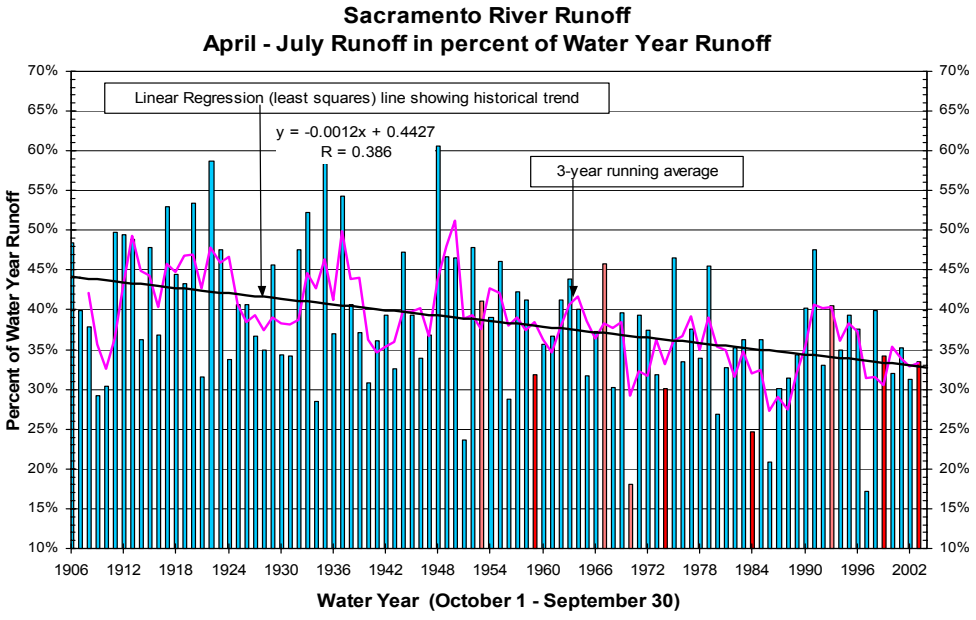
When precipitation falls in higher elevation areas, it falls as rain or snow depending on air temperature. As the temperature of the atmosphere increases due to climate change, the "snowline" will begin at higher and higher elevations. This will mean more precipitation falls as rain and less as snow, so a greater percentage of precipitation will run off rather quickly, rather than staying on the ground as snow and melting slowly. Assuming no change in total precipitation, Dr. Cayan estimated that the water content of the Sierra snowpack would be as follows:

YEAR	SIERRA SNOWPACK As compared to the current average snowpack
2030	95 percent
2060	64 percent
2090	48 percent

A greater percentage of precipitation falling as rain and a smaller percentage falling as snow would have very significant impacts on streamflow timing and on water supply:

1. more river runoff in the winter,
2. an increased potential for downstream flooding in the winter,
3. less river runoff in the summer, and
4. conflicts between the use of reservoirs for flood control and for water supply.

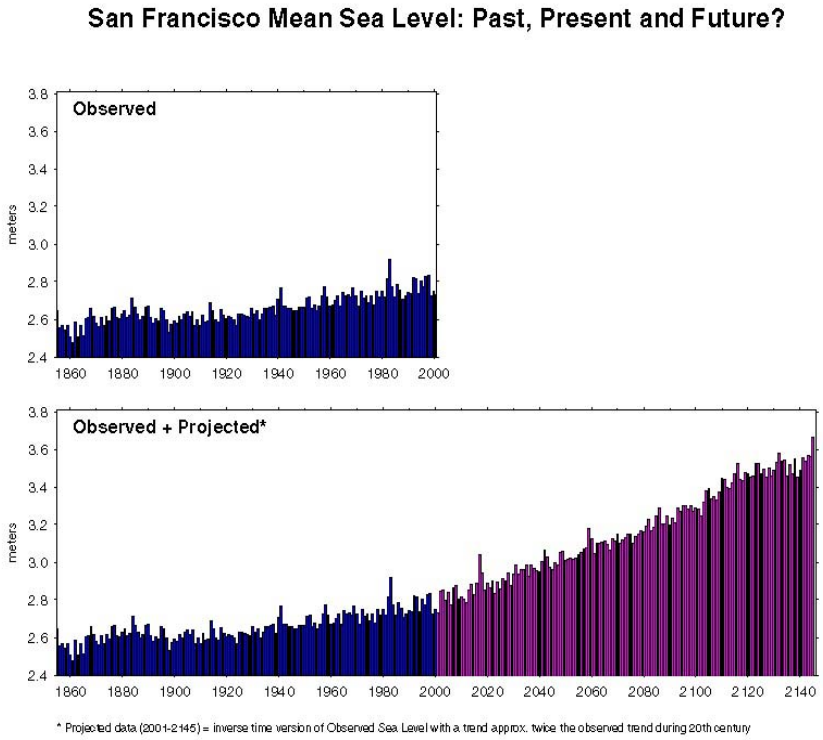
The California Department of Water Resources has shown that the runoff in the Sacramento River during the snowmelt period (April to July) decreased 11 percent during the last century, indicating that the snowpack is already shrinking:



Will Climate Change Cause the Oceans to Rise?

The oceans will rise primarily because ocean water expands as it gets warmer. Because the water can not expand downward, the oceans rise. To a lesser extent, the oceans will rise because of runoff from melting glaciers and ice fields.

The oceans rose an average of about four to eight inches during the twentieth century. Projections of sea rise over the next 100 years are about one to three feet. The impacts on coastal resources, environment, and beaches will be very significant.



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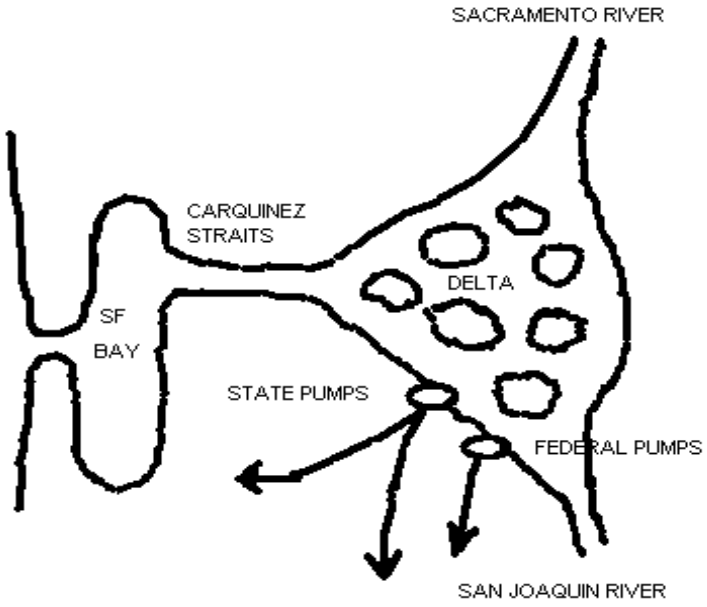
Will Ocean Rise Affect California's Water System?

Yes. The most significant will be the impact on the Delta, which is important because of the Delta's ecosystem, and because the state and federal water projects use the Delta channels to transport water north to south to the large aqueducts that serve eastern Contra Costa County, the San Joaquin Valley, the greater San Jose area, and Southern California.



Water quality in the Delta remains "fresh," provided that there is sufficient fresh water flow through the Carquinez Straits to resist salinity that tries to intrude into the Delta by diffusion from San Francisco Bay.

Sea level rise will increase water levels in the Delta and will try to push more salty San Francisco Bay water into the Delta, unless more water is released from upstream reservoirs. Releasing more water would adversely affect available water supplies. Sea level rise also will threaten the low-level lands in the Delta and put more pressure on Delta levees.

Sea level rise will increase the probability of seawater intrusion into coastal aquifers. It will also have significant adverse impacts on coastal resources, low-lying structures, and beaches.

Will There Be More or Less Precipitation?

With a warmer atmosphere, more water will evaporate from the oceans, other water bodies, and from the land. This will result in more rainfall on average, but climate models do not show any consensus on whether California will receive more or less precipitation. Whether precipitation will change for California is a major unknown.

What Did the Scientists say about Climate Change and Our Water Resources?

1. Climate change is a real problem and a lot of the consequences are unavoidable.
2. The climate change debate is now about the magnitude of the problem; what should we do about it and when; and how much will it cost and who should pay?
3. There is compelling evidence that the climate change will pose serious challenges to our water systems.
4. Changes in flooding potential could be very challenging and costly.
5. The impacts of climate change will not necessarily be linear; i.e. there may be sudden changes. For example, ocean currents may shift dramatically, although this is unlikely.
6. Water managers are not prepared for climate change. Reliance on past water data to project the future water supplies would be wrong.
7. Water quality probably will be affected because of temperature changes and fires.

What Did the Scientists Recommend?

1. Water managers and policy makers should give considerable thought about how climate change may affect their water systems.
2. It will be important for water managers to have options: water markets, joint surface and groundwater operations, coordinated facility operations, urban and agricultural water conservation, allowing cropping changes and fallowing, wastewater use, and desalination.
3. Uncertainties should not be used to delay or avoid taking action.

What Will the Select Committee Be Doing Next?

The committee will hold additional hearings to discuss how federal, state, and local water agencies water agencies are planning for climate change. At the end of its hearings, the committee may recommend changes in state law, policy, or funding in order to protect the state's water supply and environment.

Note: With the exception of the drawing on page 7, all of the diagrams/charts included in this summary were included in the presentations given by the scientists.